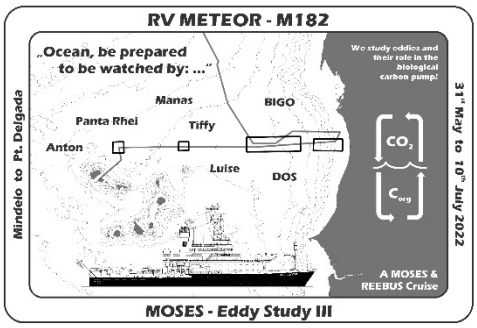
RV METEOR – M182

31.05. - 10.07.2022, Mindelo - Pt. Delgada

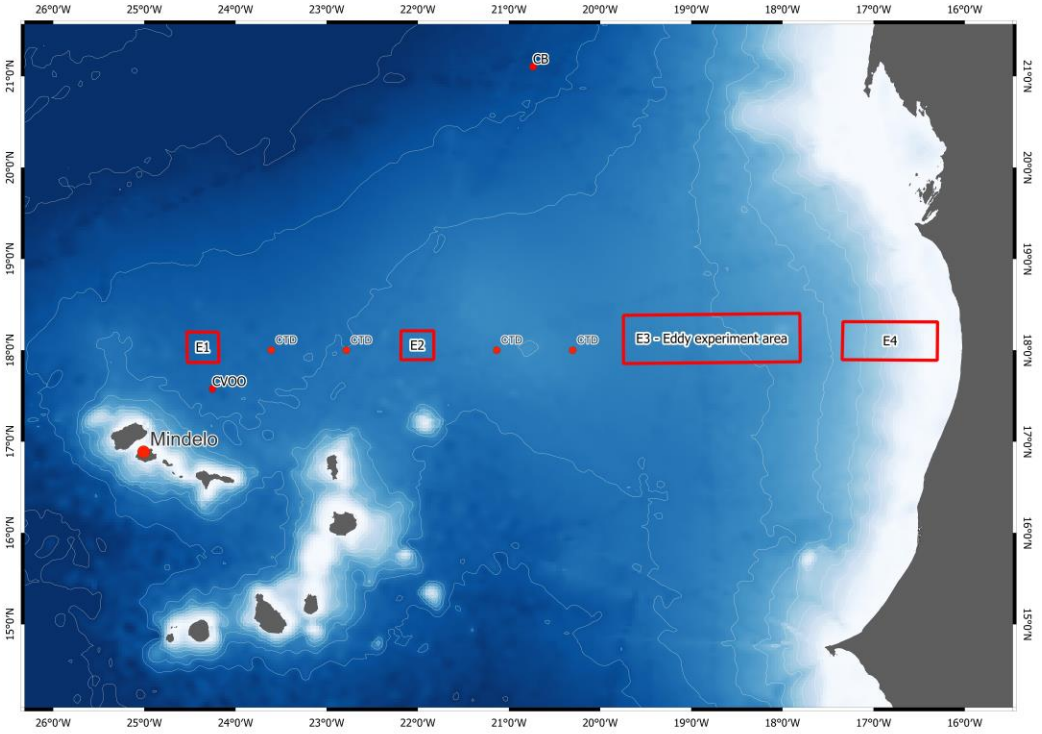


1st Weekly Report

31.05. - 05.06.2022

Weekly reports are always a challenge that involve a lot of work and at the same time can keep you from doing your own science. Nonetheless, once I start writing I enjoy reflecting on the past week of science. For 27 years, this job has fascinated me and talking about it is a source of great pleasure.

My name is Jens Greinert and I am the Chief Scientist of the RV METEOR expedition M182. Together with 27 other international scientists from the Netherlands, UK, Taiwan, Switzerland Austria and Germany, we embarked on a research expedition. The goal of this expedition is to study the transport of organic matter from the surface to the deep sea at about 3700 m. In detail, we will investigate how biogeochemical processes inside and outside eddies, which are circulating water masses with a diameter of 80 to 150 km, differ. Eddies are typical phenomena of the eastern ocean boundary systems, called upwelling regions. In upwelling regions, the cold and nutrient-rich water is transported from the deep sea up to the oceans surface. Due to the Earth's rotation, upwelling occurs on the eastern side of the oceans like for example, along the NW African coast off Mauritania. In addition, to the biochemical processes in the water column, we also want to analyze whether the transport of organic material to the seafloor is modulated or altered by these eddies.



Working areas of M182

To conduct this kind of research, we started planning the expedition back in 2017. Originally, the expedition was planned for 2019 on the RV MARIA S MERIAN, but many expeditions were changed and postponed due to COVID-19 pandemic. Consequently, the third MOSES Eddy Study is once again hosted on the RV METEOR this time around. The M182 expedition started at 9:00 am local time on 31.05.2022 in Mindelo on Sao Vicente, which belongs to the archipelago of Cape Verde in the Atlantic Ocean at 16°53' N and 25° 00' W. All scientists and part of the ship crew arrived one or several days before departure. The ship crew consisting of 33 persons includes bridge, deck, engine and mess personnel.

The objective of the cruise is to study the biochemical processes in the water and on the seafloor along an east-west transect from Cape Verde to Mauritania along the 18° N longitude. Along this transect, four specific work areas have been selected for seafloor/benthic studies (areas E1 through E4). In particular, work area E3 is expected to be our “eddy hunting area” where one eddy will be selected to conduct a high-resolution sampling regime.

Scientist and technician on board M182.


A full deck on RV METEOR

Scientific Equipment on M182

The scientific equipment we bought on board is of great variety. From Kiel, we sent 11 containers and some last-minute airfreight boxes start towards Mindelo. The ship is now full of large-scale equipment on deck, many different analytical instruments and electronic equipment in the laboratories. M182 is packed with standard and routine equipment but also with some newly developed prototypical developments.

To obtain sediment samples we have brought a Multicorer (MUC). The MUC is equipped with a small lamp and camera to survey the seafloor before sampling. Furthermore, the MUC is designed to plunge 7 cores of 10 cm diameter that sample the upper 30 to 40 cm of sediment. Another device to sample the sediment is the Gravity corer (GC). The GC is an archaic sampling device that uses a 1.5-ton weight to push a metal core up to 6 m into the seafloor. For water column sampling, we use a combined water sampler - rosette and CTD instrument (CTD only for short) that has 24x10L, each of which can be closed at desired depths and bring the sample to the ships deck for further processing. Using a similar mechanism, we also brought a multi-net that is equipped with 9 nets, each of which can be closed at different water depths and bring biological samples to the ships deck for further processing.

In addition to these standard instruments, we brought three lander systems that can be deployed on the seafloor for several days or months. Two lander systems are different types of the Biogeochemical Observatory (BIGO) lander, and the third is a Bottom Boundary Lander (BBL). Although the landers are technically challenging and complex, they are very reliable and have now been deployed for more than 15 years.

New additions are the small fleet of autonomous platforms and an extended version of a towed camera system. The camera system called “Ocean Floor Observation System (OFOS)” has been further developed at GEOMAR into the Extended OFOS or XOFOS. The XOFOS was christened Manas after the greatest hero of Kyrgyzstan and is a multi-sensor platform is towed by the ship through the water column or over the seafloor to take high-resolution (4K) images of the seafloor and analyze its nature. XOFOS is equipped with several camera systems: one camera faces forward, while another faces downward and records video and still images throughout the deployment. Additionally, a stereographic camera system can be attached in front of XOFOS to take high-resolution images of small animals and particularly gelatinous organisms that are difficult to capture intact with the Multinet. Furthermore, XOFOS is also equipped with CTD sensors, 10 water samplers, and a downward-facing ADCP.

Finally, we brought four autonomous underwater vehicles. Three autonomous systems are AUVs: “Tiffy” that is specialized for deep diving down to 6000 m by use of its torpedo-shaped system, “Anton” and “Luise” that can dive to 500 m and hover in the water column or can be pre-programmed to fly through the water and take optical or acoustic measurements from the seafloor. The fourth autonomous system is a deep-sea rover (DSR) that travels over the seafloor in a manner similar to the Mars rover. The GEOMAR-developed “Panta Rhei” can operate in water depths up to 6000 m.

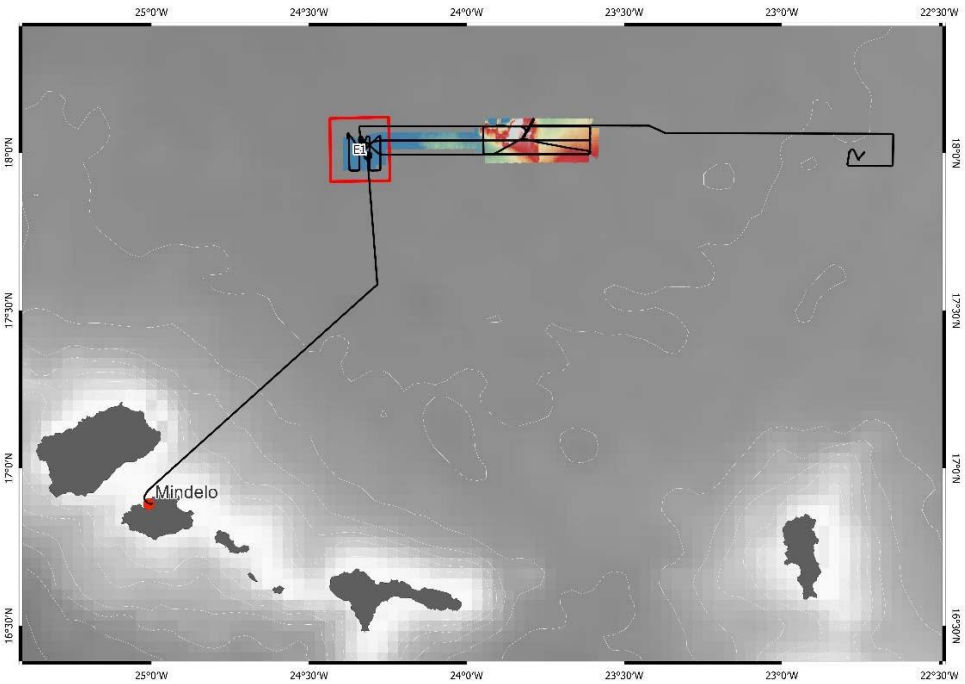
Work of last week

The first task after leaving Mindelo was to sample the Cabo Verde Ocean Observatory (CVOO) monitoring site by deploying the CTD and a multinet. At standard depths, we capped the bottles for various chemical analyses. We then sailed to the westernmost work area “E1” to deploy two transponders that would later aid in Tiffy's navigation and also deployed a CTD. The first day of sampling was completed with a MUC that brought the first sediment on deck at 23:45 local time. During the night we conducted multibeam echo sounder mapping that will provide bathymetric maps of the seafloor and help guide the deployment of the equipment but also serve a basis for geological interpretations.

On June 1, a BIGO lander was deployed in work area “E1” to measure benthic fluxes for several days. Subsequently, XOFOS was deployed for the first time and all its functions were checked and tested. More multibeam echo sounder mapping was conducted as the RV Meteor approached the next CTD position in work area “E2”. At “E2”, a second multinet and third CTD cast were conducted. The multibeam echo sounder survey revealed a seamount structure, which we selected for the second BIGO deployment in the early night of June 2. To save time, the heel frame normally used to deploy the lander was sent on a reconnaissance trip to 40° North to explore the lander vicinity.

On the morning of June 3, a MUC was taken near the lander position before we returned to the “E1” area to deploy the Panta Rhei rover, followed by a second XOFOS surveyed the “E1”. After taking another sediment core for a colleague at GEOMAR, we continued mapping to the east to sample the top 1000 m of the water column for biological purposes and to conduct another wildlife monitoring station with the XOFOS in the “E1” mound area.

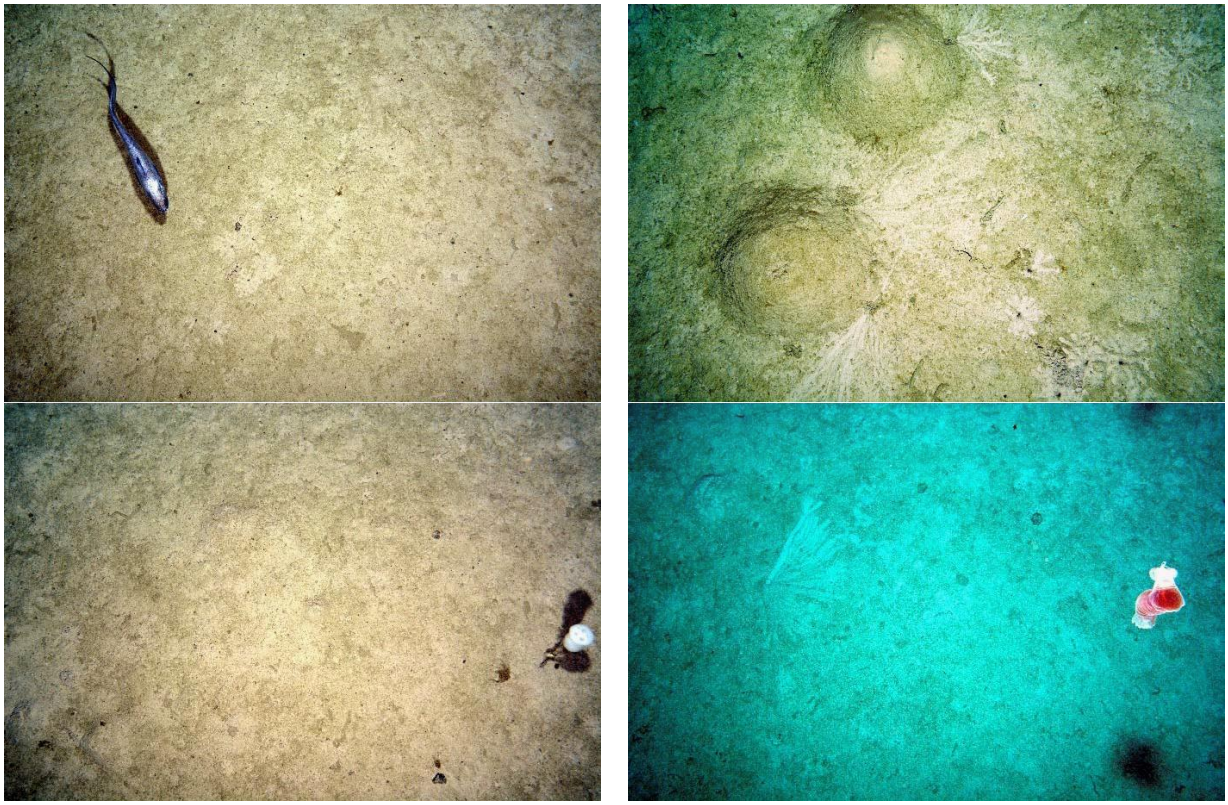
In the early evening of June 4, we sailed further west to sample the next multinet on the morning of June 5th, CTD, and a MUC. As I am writing this report, the XOFOS is still exploring the seafloor at this site, which we will leave in the early morning to return to E1 Hill for another BIGO deployment.



Cruise track and first bathymetric map of M182.

First results from the biologists

The goal of the deep-sea biologists is to understand the diversity and vertical distribution of pelagic fauna larger than 1 cm. These include organisms such as jellyfishes and other gelatinous zooplankton, crustaceans, fishes and cephalopods. On this cruise we are particularly interested in how mesoscale features, such as eddies, structure the vertical distribution of the organisms, in comparison to background ocean conditions. We use a multinet to capture fauna, and to reconstruct the vertical distribution, abundance and community composition. The first deployments so far have shown a clear difference in abundance and diversity between day and night casts, and also between shallow and deeper layers. Collected fauna include impressive amphipods and black deep-sea fishes. Since some gelatinous fauna are too fragile to be captured by nets, we also collect in situ observations via underwater video transects.



Some impressions of the seafloor in 3600m water depth

For this approach we use the XOFOS system in "pelagic mode" where we tow the system at 1 knot horizontally through the water column at the same 9 depths as where we close the nets of the multinet. Using the CTD we also collect water from these depths which we then filter to collect environmental DNA, genetic traces that organisms leave behind in the water. Today we installed a single beam echosounder which will provide another view on the distribution and abundance of midwater fauna. This tool visualizes the aggregations of biomass in the water column. We use this echosounder to document the mass movement of organisms from the deep sea to shallow waters at night. This phenomenon also known as vertical migration, is the largest animal migration on the planet and happens on a daily basis. It allows deep-sea animals to take advantage of the productivity in the upper water column. The XOFOS brought some nice footage from the seafloor. Very first images show string bioturbation and feeding activity on the seafloor but little megafauna living on the sediment.

Things that can go wrong

Within the mix of planning, things can go wrong. This time it's an O-ring from “Tiffy” that needs to be replaced. An O-ring is a rubber seal for pressure-resistant electronic bottles, which is essential for the navigation unit of “Tiffy”. However, once we noticed that it needed replacement and wanted to install a new o-ring, we realized that the spare parts list of the AUV was incorrect. A replacement O-ring could not be found on the ship (US extra size), so we will have to have a personal shipment of the O-ring and another box of spare parts brought to the ship. The plan is set to meet a pilot boat in the coming days and deliver the much-needed equipment at sea.

As of now (Sunday 17:00) we have the 28th equipment deployment ongoing, there are no real delays in the station work and we hope for calm seas that will allow safe recovery of the BIGO lander and Panta Rhei in the upcoming days. The scientists are all well and relived that after countless COVID-19 PCR, antigen texts and strict mask-mandates can now live in a COVID-free bubble for the next six weeks.

With the best wishes from all participants,

Jens Greinert

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